US011368069B2

(12) **United States Patent**
Imamura et al.

(10) **Patent No.: US 11,368,069 B2**
(45) **Date of Patent: Jun. 21, 2022**

(54) **ROTARY ELECTRIC MACHINE UNIT**

(71) Applicant: **HONDA MOTOR CO., LTD.**, Tokyo (JP)

(72) Inventors: **Takehiro Imamura**, Saitama (JP); **Misa Aneha**, Saitama (JP)

(73) Assignee: **HONDA MOTOR CO., LTD.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 228 days.

(21) Appl. No.: **16/800,738**

(22) Filed: **Feb. 25, 2020**

(65) **Prior Publication Data**

US 2020/0274418 A1 Aug. 27, 2020

(30) **Foreign Application Priority Data**

Feb. 25, 2019 (JP) JP2019-031953

(51) **Int. Cl.**
H02K 5/22 (2006.01)
H02K 9/19 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H02K 5/225*** (2013.01); ***H02K 3/52*** (2013.01); ***H02K 5/22*** (2013.01); ***H02K 9/19*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC .. H02K 3/50; H02K 3/52; H02K 9/19; H02K 5/225; H02K 16/00; H02K 5/22;
(Continued)

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,712,029 A * 12/1987 Nold H02K 5/225 174/15.3
2012/0229005 A1 9/2012 Tominaga et al.
(Continued)

FOREIGN PATENT DOCUMENTS

CN 102763309 A 10/2012
CN 104541437 A 4/2015
(Continued)

OTHER PUBLICATIONS

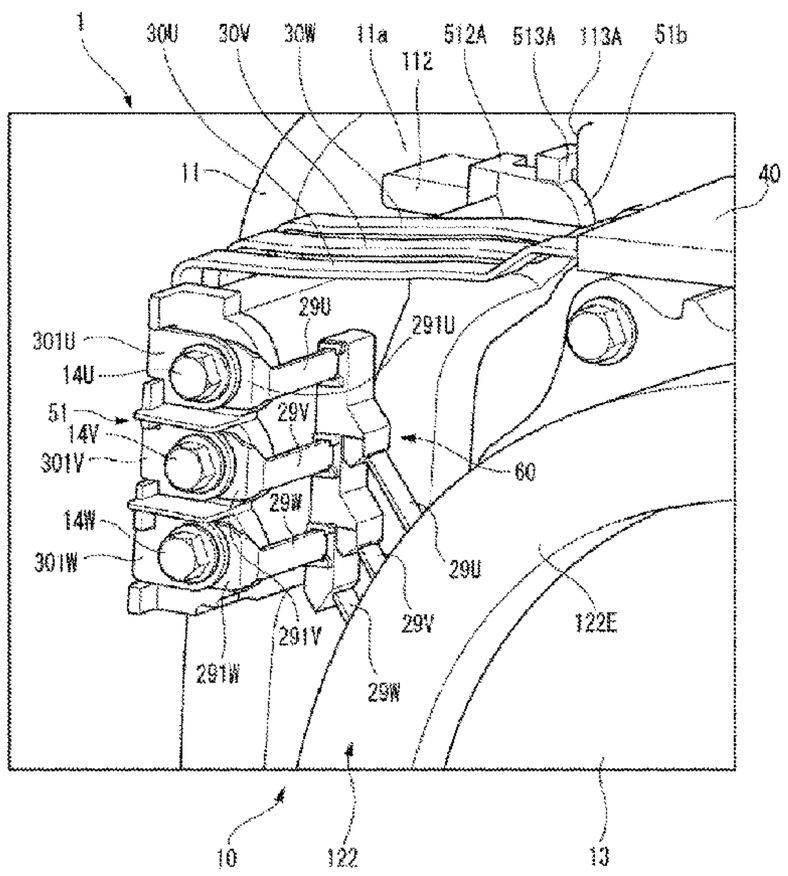
Shioji et al, Terminal Connection Structure of Rotary Electric Machine, Jun. 11, 2015, JP 2015109742 (English Machine Translation) (Year: 2015).*
(Continued)

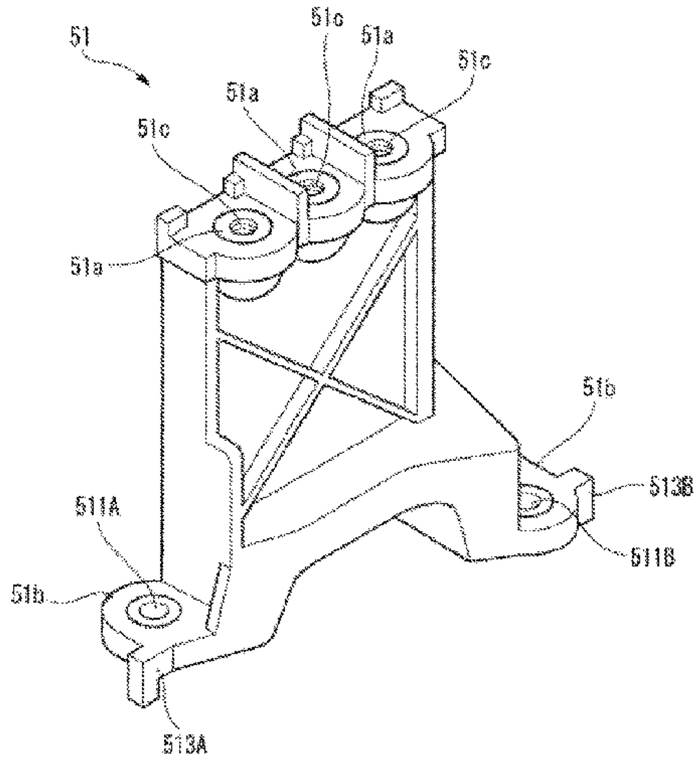
Primary Examiner — Quyen P Leung
Assistant Examiner — Alexander A Singh
(74) *Attorney, Agent, or Firm* — Paratus Law Group, PLLC

(57) **ABSTRACT**

A rotary electric machine unit includes: a rotary electric machine; and a case that accommodates the rotary electric machine. The rotary electric machine includes: a stator core; a multi-phase coil that is attached to the stator core; a conductive member holder that collectively holds a conductive member connected to a coil end of the multi-phase coil and is disposed outside the coil end in a radial direction; and a terminal block that is fixed to a fastening surface of the case and electrically connects a terminal portion of a power distribution member with a terminal portion of the conductive member. The terminal block is disposed outside the conductive member holder in the radial direction, and at least a part of the terminal block overlaps the conductive member holder in the radial direction.

3 Claims, 7 Drawing Sheets





(51) **Int. Cl.**
H02K 3/52 (2006.01)
H02K 16/00 (2006.01)

(52) **U.S. Cl.**
CPC ***H02K 16/00*** (2013.01); *H02K 2203/09* (2013.01)

(58) **Field of Classification Search**
CPC .. H02K 2203/09; H02K 2213/03; H02K 3/28; H02K 3/522; H02K 11/30; H02K 11/33; H02K 3/505
USPC 310/71
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2015/0188376	A1	7/2015	Yamaguchi et al.	
2016/0301276	A1	10/2016	Saki et al.	
2016/0380502	A1	12/2016	Koiwai et al.	
2017/0104281	A1*	4/2017	Kurono	H01R 9/2416
2017/0110929	A1*	4/2017	Egami	H02K 5/225
2020/0052540	A1*	2/2020	Mashiko	H01B 7/40

FOREIGN PATENT DOCUMENTS

CN	106100193	A	11/2016
EP	0500954	A1	9/1992
JP	H04-117150	A	4/1992
JP	2008-125170	A	5/2008
JP	2009-284659	A	12/2009
JP	2015109742	A *	6/2015
JP	2017-017798	A	1/2017
JP	2017-130290	A	7/2017

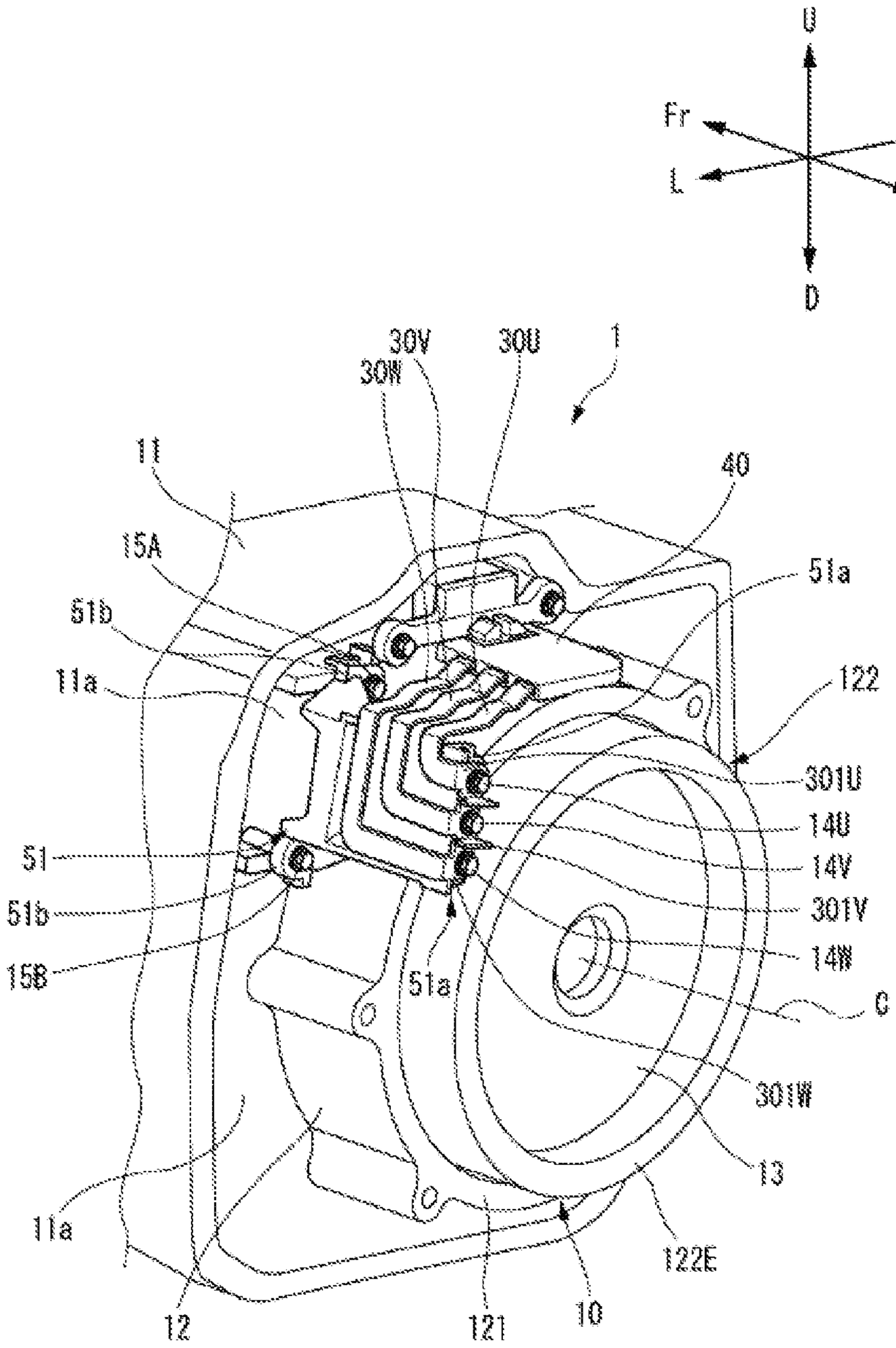
OTHER PUBLICATIONS

Nov. 17, 2020, Japanese Office Action issued for related JP Application No. 2019-031953.

Dec. 17, 2021, Chinese Office Action issued for related CN Application No. 202010100638.8.

* cited by examiner

FIG. 1


U
Fr
R
L
Rr
D
30V
30U
1
30W
11
40
15A
51a
51b
122
11a
301U
14U
51
14V
301V
51b
14W
15B
51a
C
301W
13
11a
122E
12
121
10

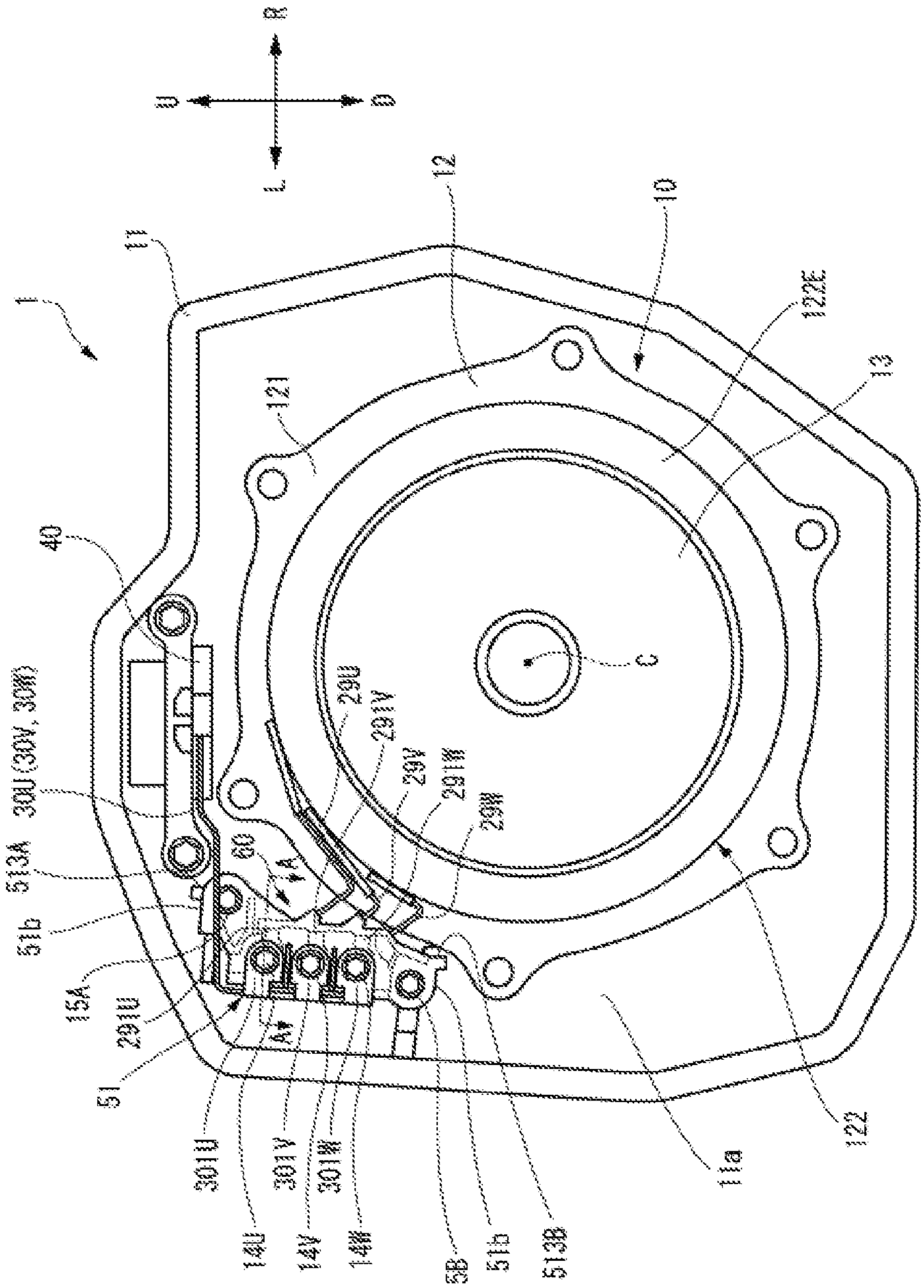

R
L
U
D
12
10
11
122E
13
121
40
30U (30V, 30W)
513A
51b
15A
291U
51
60
A
A'
C
29U
291V
29V
291W
29W
301U
301V
301W
441
442
443
15B
51b
513B
11a
122

FIG. 2

FIG. 3

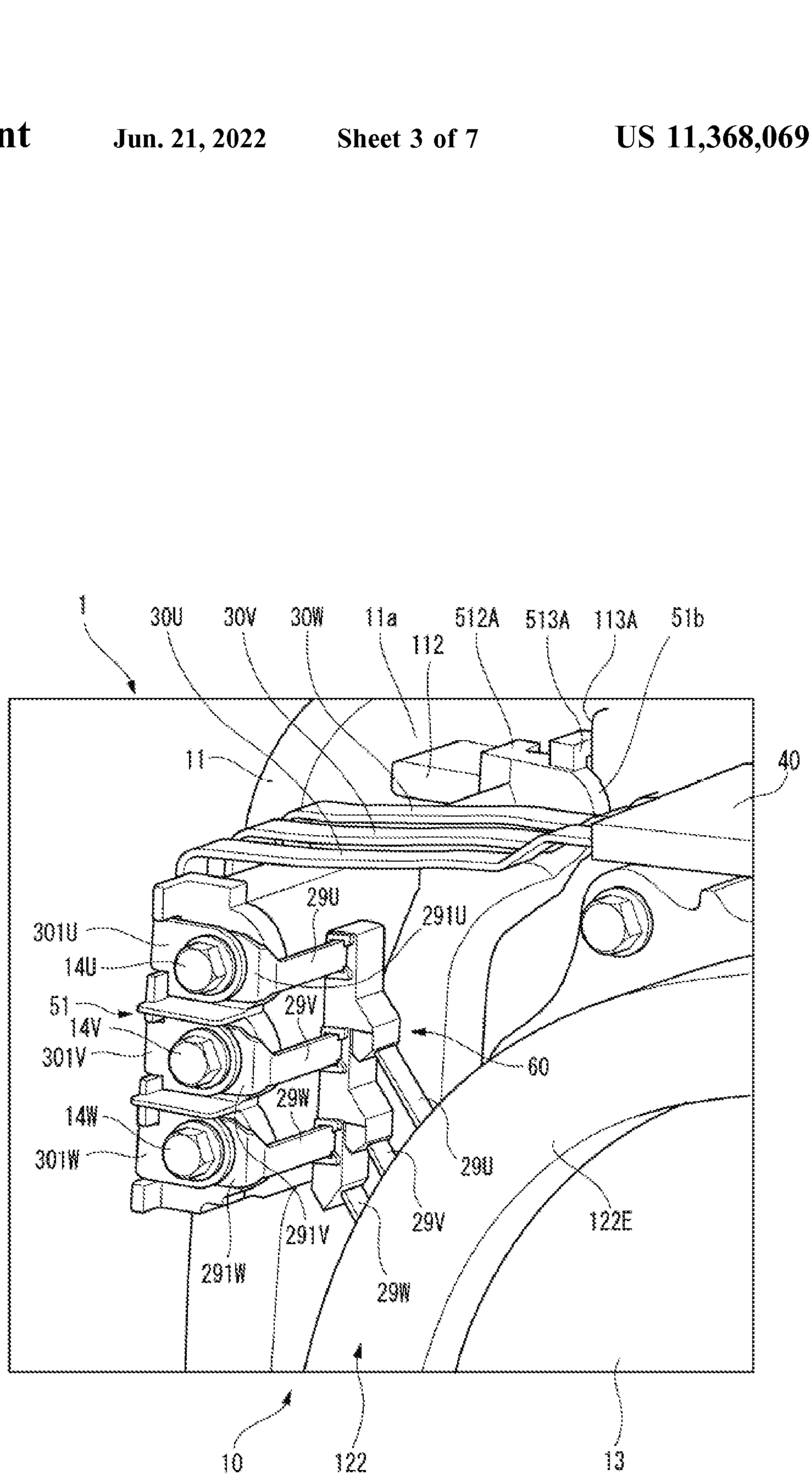

1
30U
30V
30W
11a
112
512A
513A
113A
51b
11
40
29U
291U
301U
14U
51
29V
14V
301V
60
29W
14W
301W
29U
29V
122E
291V
291W
29W
10
122
13

FIG. 4

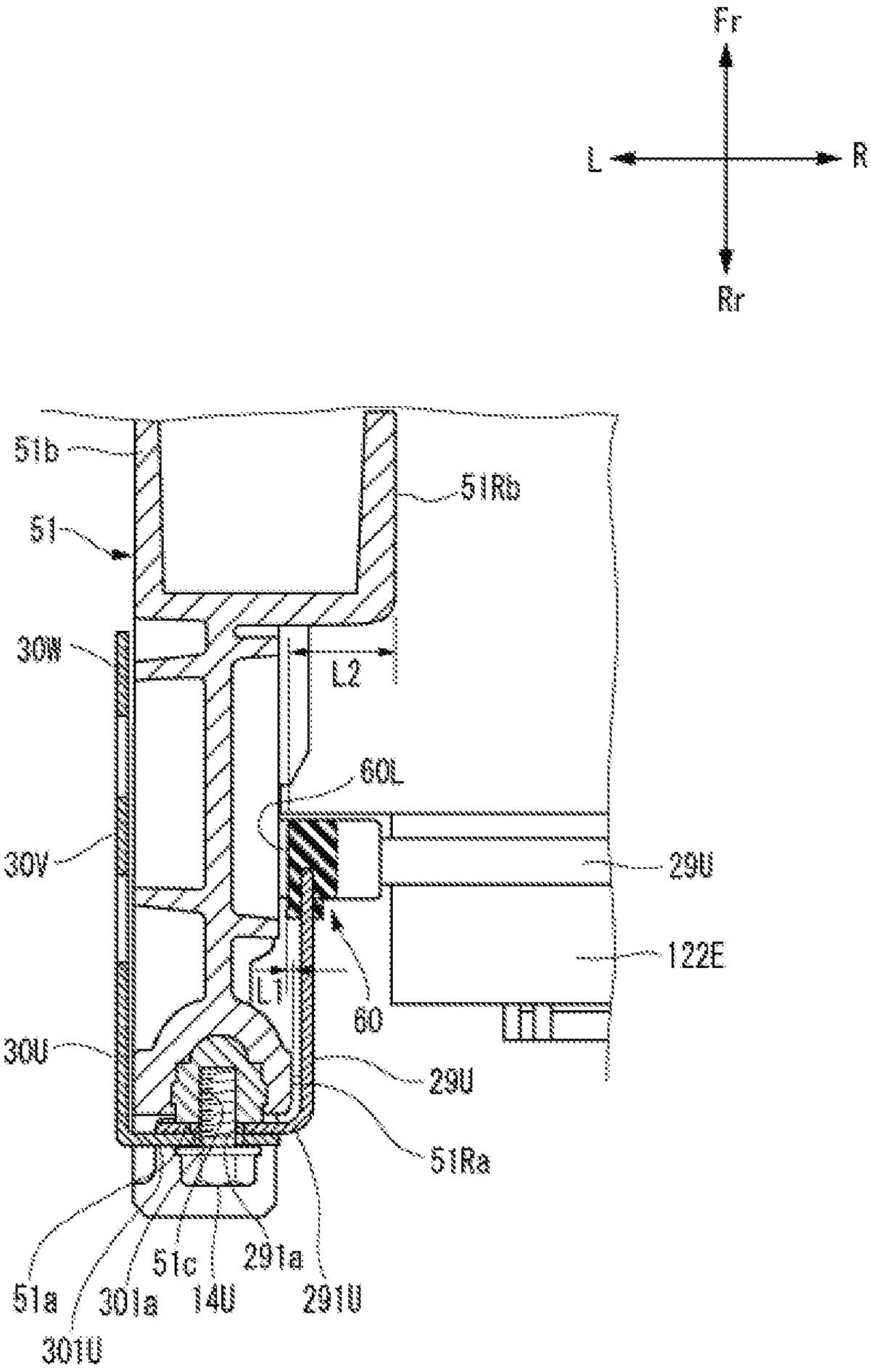

Fr
L
R
Rr
51b
51Rb
51
30W
L2
60L
30V
29U
122E
L1
60
30U
29U
51Ra
51c
291a
51a
301a
14U
291U
301U

FIG. 5

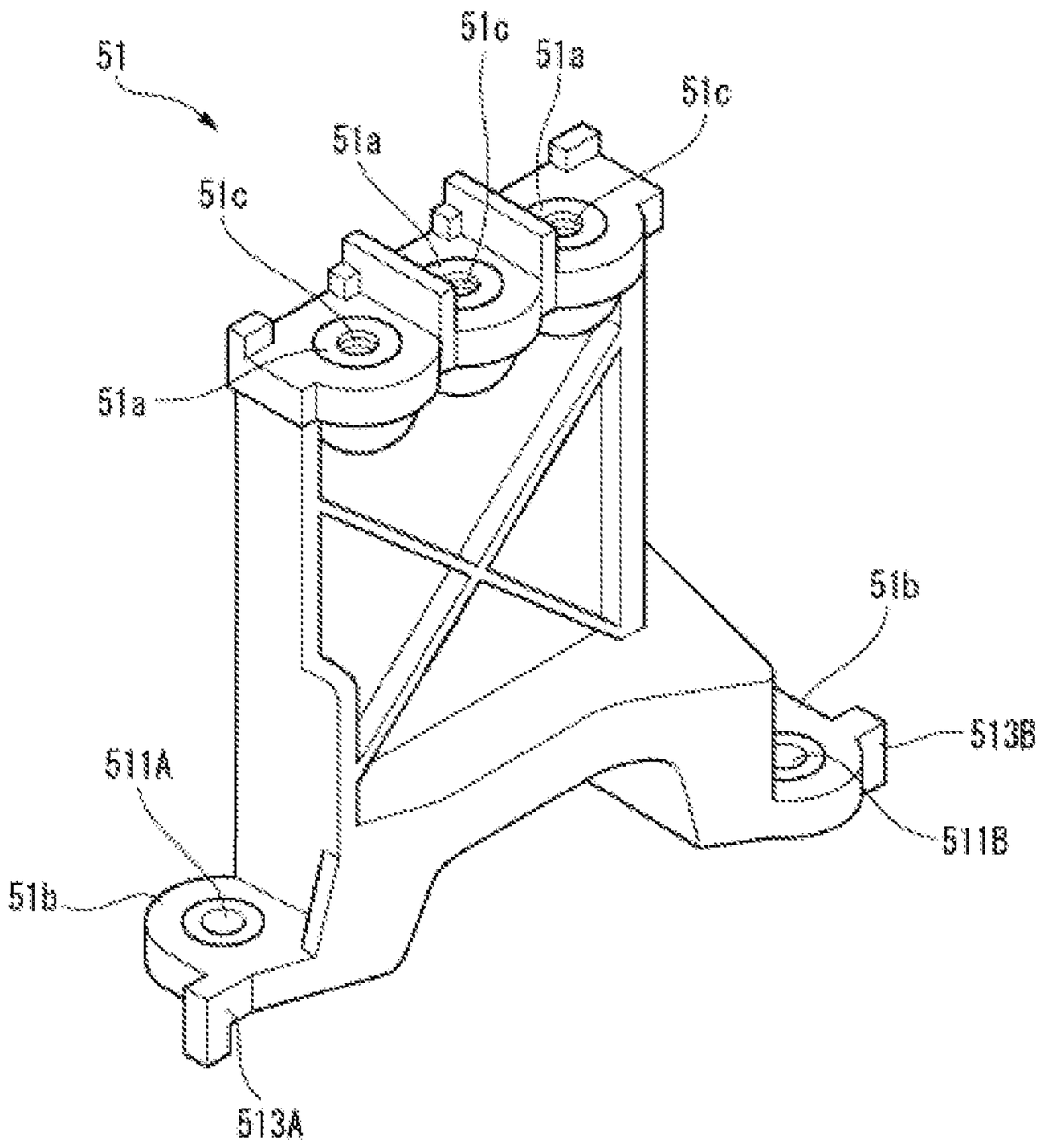


FIG. 6

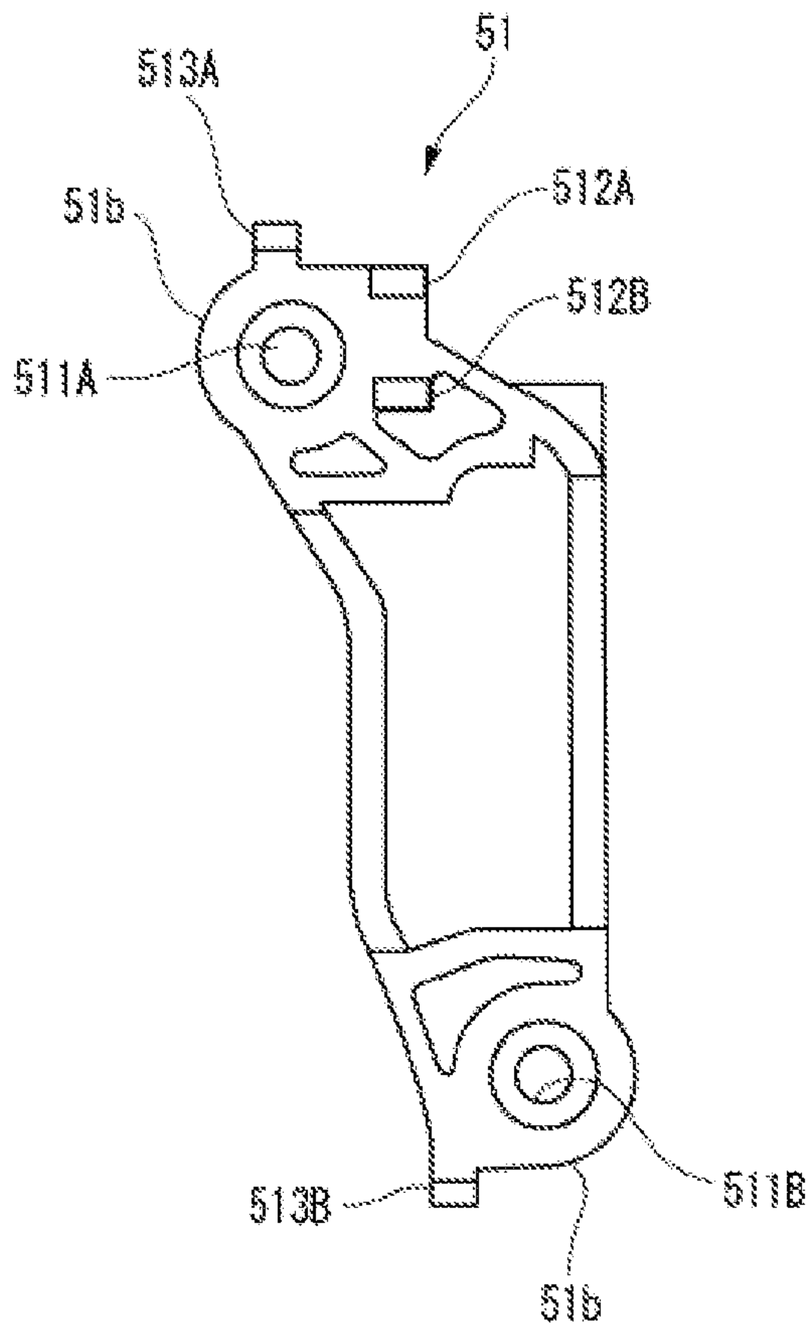
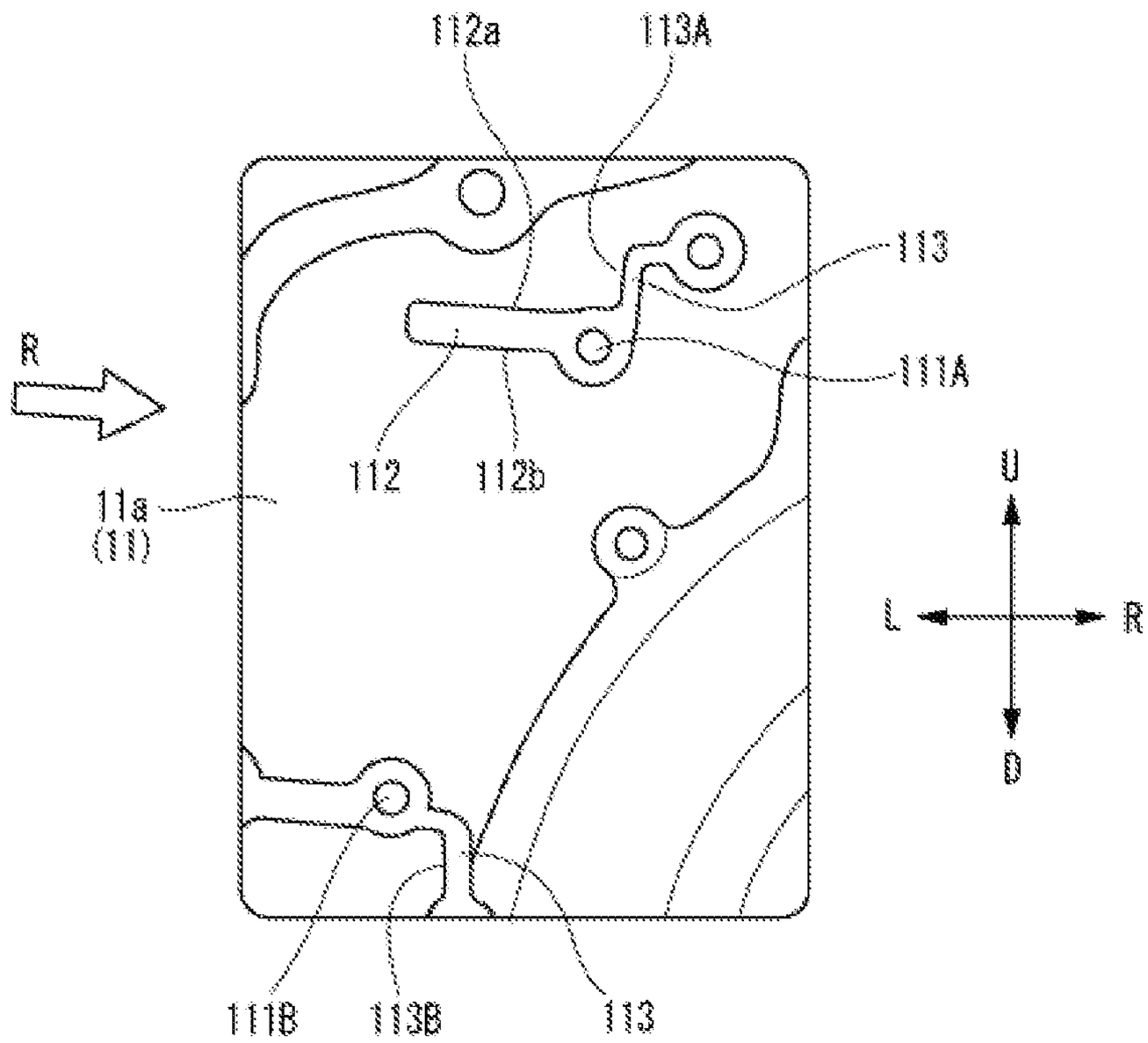


FIG. 7



ROTARY ELECTRIC MACHINE UNIT

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims the benefit of priority of Japanese Patent Application No. 2019-031953, filed on Feb. 25, 2019, the content of which is incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to a rotary electric machine unit mounted on an electric vehicle or the like.

BACKGROUND ART

Conventionally, a rotary electric machine unit is mounted as a drive source in an electric vehicle or the like. For example, JP-A-2009-284659 discloses a motor unit. In the motor unit of JP-A-2009-284659, a motor terminal block is attached to a wall portion of a case, and a motor terminal extending from a motor winding and an inverter cable of an inverter are electrically connected to each other by the motor terminal block.

However, in the motor unit of JP-A-2009-284659, since the motor terminal block is disposed at a position overlapping with a stator in a radial direction of a motor, and the motor terminal is attached from a longitudinal direction (axial direction of the motor) of the motor terminal block, the motor terminal block and the motor terminal protrude in the axial direction of the motor, so that there is a problem that it is difficult to reduce size of the motor unit.

SUMMARY

The present invention provides a rotary electric machine unit that can be reduced in size by reducing a space occupied by a terminal block and a conductive member holder.

According to an aspect of the present invention, there is provided a rotary electric machine unit including: a rotary electric machine; and a case that accommodates the rotary electric machine, wherein: the rotary electric machine includes: a stator core; a multi-phase coil that is attached to the stator core; a conductive member holder that collectively holds a conductive member connected to a coil end of the multi-phase coil and is disposed outside the coil end in a radial direction; and a terminal block that is fixed to a fastening surface of the case and electrically connects a terminal portion of a power distribution member with a terminal portion of the conductive member; and the terminal block is disposed outside the conductive member holder in the radial direction, and at least a part of the terminal block overlaps the conductive member holder in the radial direction.

Effects

According to the present invention, since the conductive member holder is disposed outside the coil end in the radial direction, the conductive member holder can be prevented from protruding in the axial direction. Since the terminal block that electrically connects the terminal portion of the power distribution member with the terminal portion of the conductive member is disposed outside the conductive member holder in the radial direction, the terminal block can be prevented from protruding in the axial direction, so that a length of the rotary electric machine in the axial direction can be shortened. In addition, since at least a part of the terminal block overlaps the conductive member holder in the radial direction, a length of the rotary electric machine in the radial direction can also be shortened. Therefore, the rotary electric machine unit can be reduced in size.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view showing an overall configuration of a rotary electric machine unit according to an embodiment of the present invention;

FIG. **2** is a view of the rotary electric machine unit of FIG. **1** as viewed from an axial direction;

FIG. **3** is a perspective view of a periphery of a terminal block of the rotary electric machine unit of FIG. **1**;

FIG. **4** is a sectional view taken along a line A-A of FIG. **2**;

FIG. **5** is a perspective view of the terminal block of the rotary electric machine unit of FIG. **1**.

FIG. **6** is a view showing an attachment surface of the terminal block of FIG. **5**; and

FIG. **7** is a view showing a fastening surface of a case of the rotary electric machine unit of FIG. **1**.

DESCRIPTION OF EMBODIMENTS

An embodiment of a rotary electric machine unit according to the present invention will be described below with reference to the accompanying drawings.

First, an overall configuration of a rotary electric machine unit according to an embodiment of the present invention will be described with reference to FIGS. **1** and **2**. A rotary electric machine unit **1** shown in FIG. **1** is a traveling motor unit mounted on a vehicle such as a hybrid automobile or an electric vehicle. However, the rotary electric machine unit according to the present invention is not limited to the traveling motor unit, but can also be applied to a motor unit for power generation, a motor unit for other applications, or a rotary electric machine unit other than for the vehicle.

In this specification, in order to simplify the description, front, rear, left, right, upper and lower directions of the rotary electric machine unit **1** are defined as shown in the drawings, and a front direction thereof is indicated by Fr, a rear direction thereof is indicated by Rr, a right direction thereof is indicated by R, a left direction thereof is indicated by L, an upper direction is indicated by U, and a lower direction is indicated by D, respectively. The directions shown in the drawing are independent of directions of the vehicle or the like on which the rotary electric machine unit **1** is mounted. In the following description, an axial direction refers to a direction along a rotation axis C of the rotary electric machine unit **1**. In addition, a circumferential direction refers to, in a state in which the rotation axis C is visible as a point, a direction along a circumference of a circle drawn around the point. On the other hand, a radial direction refers to a direction from the point toward a circle or a direction from the circle to the point.

As shown in FIG. **1**, the rotary electric machine unit **1** includes a motor **10** as a rotary electric machine and a case **11** that accommodates the motor **10**. The motor **10** includes a stator **12** and a rotor **13**. The rotor **13** has an annular shape and is externally fitted to a shaft (not shown). A case cover (not shown) that seals an opening portion of the case **11** is attached to the case **11**.

The stator **12** includes a stator core **121** and a coil **122** attached to the stator core **121**.

The stator core **121** is formed in a cylindrical shape surrounding the rotor **13** from the outside in the radial direction, and is fixed to a fastening surface **11***a* of the case **11** by a fastening member such as a bolt.

The coil **122** is a three-phase coil formed of a U-phase, a V-phase, and a W-phase. The coil **122** may be a segment coil or a continuous winding. The coil **122** includes coil ends **122**E protruding from end surfaces of the stator core **121** to both sides in the axial direction. Incidentally, in the drawings, in the present embodiment, since only the coil end **122**E on a side opposite to the fastening surface **11***a* of the case **11** is targeted, in the drawings, the coil end **122**E on the fastening surface **11***a* side of the case **11** is omitted.

Referring also to FIG. **3**, in addition to the motor **10**, a conductive member holder **60** that collectively holds first bus bars **29**U, **29**V and **29**W and a terminal block **51** for electrically connecting the first bus bars **29**U, **29**V and **29**W and second bus bars **30**U, **30**V and **30**W are provided inside the case **11**.

The conductive member holder **60** collectively holds the three first bus bars **29**U, **29**V and **29**W as a conductive member connected to the coil end **122**E of the coil **122**, and is disposed outside the coil end **122**E in the radial direction.

One end of each of the second bus bars **30**U, **30**V and **30**W is connected to a connector portion (not shown) connected to a power conversion device (not shown). The second bus bars **30**U, **30**V and **30**W are three-dimensional bus bars that are bent in a front-rear direction, an upper-lower direction, and a left-right direction, respectively. A part of the second bus bars **30**U, **30**V and **30**W is covered with a cover member **40**.

The terminal block **51** is fixed to the fastening surface **11***a* of the case **11**, and electrically connects terminal portions **301**U, **301**V and **301**W of the three second bus bars **30**U, **30**V and **30**W with terminal portions **291**U, **291**V and **291**W of the first bus bars **29**U, **29**V and **29**W, respectively.

As shown in FIGS. **4** and **5**, the terminal block **51** has pedestal surfaces **51***a* on a side opposite to the fastening surface **11***a* of the case **11**. The pedestal surfaces **51***a* are provided with three bolt holes **51***c* (FIG. **4**) to which bolts **14**U, **14**V and **14**W as a fixing member are attached. The terminal portions **301**U, **301**V and **301**W of the second bus bars **30**U, **30**V and **30**W and the terminal portions **291**U, **291**V and **291**W of the first bus bars **29**U, **29**V and **29**W are provided with hole portions **301***a*, **291***a* (FIG. **4**) into which the bolts **14**U, **14**V and **14**W are inserted, respectively. Both of the terminal portions **301**U, **301**V and **301**W and the terminal portions **291**U, **291**V and **291**W are disposed so as to overlap each other on the pedestal surfaces **51***a* of the terminal block **51**, and are fixed to the pedestal surfaces **51***a* by the bolts **14**U, **14**V and **14**W, respectively.

As described above, since the pedestal surfaces **51***a* of the terminal block **51** on which the terminal portions **30**W, **301**V and **301**W of the second bus bars **30**U, **30**V and **30**W and the terminal portions **291**U, **291**V and **291**W of the first bus bars **29**U, **29**V and **29**W are disposed are positioned on the side opposite to the fastening surface **11***a* of the case **11**, fastening work of the bolts **14**U, **14**V and **14**W can be easily performed.

The terminal block **51** is disposed outside the conductive member holder **60** in the radial direction. Since the conductive member holder **60** is disposed outside the coil end **122**E of the coil **122** in the radial direction, the conductive member holder **60** can be prevented from protruding in the axial direction. In addition, since the terminal block **51** is disposed outside the conductive member holder **60** in the radial direction, the terminal block **51** can be prevented from protruding in the axial direction, so that a length of the motor **10** in the axial direction (directions of arrows Fr, Rr) can be shortened.

The terminal block **51** is disposed outside the conductive member holder **60** in the radial direction, and at least a part of the terminal block **51** overlaps the conductive member holder **60** in the radial direction. More specifically, referring to FIG. **4**, a left end portion **60**L of the conductive member holder **60** is positioned on a left side of a right end surface **51**Ra of the pedestal surface **51***a* of the terminal block **51**, and is positioned on a left side of a right end surface **51**Rb of a fixing portion **51***b*. In other words, there is an overlap region indicated by a reference symbol L**1** in FIG. **4** between the left end portion **60**L of the conductive member holder **60** and the right end surface **51**Ra of the pedestal surface **51***a* of the tenninal block **51**, there is an overlap region indicated by a reference symbol L**2** in FIG. **4** between the left end portion **601**L of the conductive member holder **60** and the right end surface **51**Rb of the fixing portion **51***b* of the terminal block **51**, and a part of the conductive member holder **60** is disposed in a nested manner with respect to the terminal block **51**.

Since at least a part of the terminal block **51** overlaps the conductive member holder **60** in the radial direction, a length of the motor **10** in the radial direction can also be shortened. Therefore, the rotary electric machine unit **1** can be reduced in size.

As shown in FIGS. **5** and **6**, the terminal block **51** includes the fixing portions **51***b* fixed to the fastening surface **11***a* of the case **11** on a side opposite to the pedestal surfaces **51***a* in the front-rear direction. The two fixing portions **51***b* are provided at upper and lower positions of the terminal block **51**, and the fixing portions **51***b* are provided with bolt insertion holes **511**A, **511**B, respectively. On the other hand, as shown in FIG. **7**, two bolt holes **111**A, **111**B for fixing the terminal block **51** are provided on the fastening surface **11***a* of the case **11**. Referring also to FIGS. **1** and **2**, the terminal block **51** is fixed to the fastening surface **11***a* of the case **11** by respectively inserting bolts **15**A, **1513** into the bolt insertion holes **511**A, **511**B, and fastening them into the bolt holes **111**A, **111**B of the fastening surface **11***a*.

As shown in FIG. **7**, a rib-like guide protrusion **112** extending in the left-right direction is provided on the fastening surface **11***a* of the case **11**.

On the other hand, as shown in FIG. **6**, one fixing portion **51***b* of the terminal block **51** is provided with a pair of upper and lower guide portions **512**A, **512**B that are guided by the guide protrusion **112** in sliding contact with two upper and lower surfaces **112***a*, **112***b* of the guide protrusion **112**.

As described above, since a part of the terminal block **51** overlaps the conductive member holder **60** in the radial direction, the terminal block **51** cannot be assembled from the axial direction (the front-rear direction of the present embodiment) with respect to the case **11** provided with the motor **10** and the conductive member holder **60**. Even if the terminal block **51** is assembled from the axial direction, the fixing portion **51***b* of the terminal block **51** interferes with the conductive member holder **60**. Therefore, the assembling of the terminal block **51** needs to be assembled such that the fixing portion **51***b* of the terminal block **51** is slid between the fastening surface **11***a* of the case **11** and the conductive member holder **60** in a direction indicated by an arrow R in FIG. **7** from a position (initial position) slightly shifted outward in the radial direction with respect to the case **11** provided with the motor **10** and the conductive member holder **60**.

At this time, the terminal block **51** is moved inward with the pair of guide portions **512**A, **512**B provided on the one fixing portion **51***b* of the terminal block **51** being moved along the guide protrusion **112** provided on the fastening surface **11***a*, so that the terminal block **51** can be moved to a mounting position accurately and easily.

As shown in FIG. **7**, the fastening surface **11***a* of the case **11** are provided with abutting surfaces **113**A, **113**B at two upper and lower positions. The abutting surfaces **113**A, **113**E are formed by side surfaces of rib-like protrusions **113** provided on the fastening surface **11***a*. n the present embodiment, the rib-like protrusion **113** having the upper abutting surface **113**A extends from the guide protrusion **112**.

As shown in FIGS. **5** and **6**, the two fixing portions **51***b* of the terminal block **51** are provided with abutting portions **513**A, **513**B that abut against the abutting surfaces **113**A, **113**B at the mounting position when the terminal block **51** is moved from the initial position to the mounting position.

According to this configuration, when the terminal block **51** is moved along the guide protrusion **112**, the abutting portions **513**A, **513**B of the terminal block **51** abut against the abutting surfaces **113**A, **113**B of the case **11**, so that the terminal block **51** can be positioned at the correct mounting position.

The above-described embodiment can be appropriately modified, improved, or the like.

For example, although the guide protrusion **112** is provided at one position of the fastening surface **11***a* of the case **11** in the present embodiment, the guide protrusion **112** may be provided at a plurality of positions of the fastening surface **11***a*, and the terminal block **51** may be provided with a plurality of pairs of guide portions **512**A, **512**B that are guided by the respective guide protrusions **112**.

In addition, the guide portions **512**A, **512**B guided by the guide protrusion **112** are not necessarily a pair, and may be only one of them.

At least the following matters are described in the present specification. Components corresponding to the above-described embodiments are shown in parentheses, but the present invention is not limited thereto.

(1) A rotary electric machine unit (rotary electric machine unit **1**) including:

a rotary electric machine (motor **10**); and

a case (case **11**) that accommodates the rotary electric machine,

wherein the rotary electric machine includes

a stator core (stator core **121**),

a multi-phase coil (coil **122**) that is attached to the stator core,

a conductive member holder (conductive member holder **60**) that collectively holds a conductive member (first bus bars **29**U, **29**V and **29**W) connected to a coil end (coil end **122**E) of the multi-phase coil and is disposed outside the coil end in a radial direction, and

a terminal block (terminal block **51**) that is fixed to a fastening surface (fastening surface **11***a*) of the case and electrically connects a terminal portion (terminal portions **301**U, **301**V and **301**W) of a power distribution member (second bus bars **30**U, **30**V and **30**W) with a terminal portion (terminal portions **291**U, **291**V and **291**W) of the conductive member, and wherein the terminal block is disposed outside the conductive member holder in the radial direction, and at least a part of the terminal block overlaps the conductive member holder in the radial direction.

According to (1), since the conductive member holder is disposed outside the coil end in the radial direction, the conductive member holder can be prevented from protruding in the axial direction. Since the terminal block that electrically connects the terminal portion of the power distribution member with the terminal portion of the conductive member is disposed outside the conductive member holder in the radial direction, the terminal block can be prevented from protruding in the axial direction, so that a length of the rotary electric machine in the axial direction can be shortened. In addition, since at least a part of the terminal block overlaps the conductive member holder in the radial direction, a length of the rotary electric machine in the radial direction can also be shortened. Therefore, the rotary electric machine unit can be reduced in size.

(2) The rotary electric machine unit according to (1),

wherein the terminal portion of the power distribution member and the terminal portion of the conductive member are disposed on a pedestal surface (pedestal surface **51***a*) of the terminal block on a side opposite to the fastening surface, and are fixed by a fixing member (bolts **14**U, **14**V and **14**W).

According to (2), since the pedestal surface of the terminal block on which the terminal portion of the power distribution member and the terminal portion of the conductive member are disposed is positioned on the side opposite to the fastening surface of the case, fastening work of the fixing member can be easily performed.

(3) The rotary electric machine unit according to (2),

wherein the terminal block includes a fixing portion (fixing portion **51***b*) fixed to the fastening surface, and

wherein the fixing portion d the pedestal surface overlap the conductive member holder in the radial direction.

According to (3), since the fixing portion and the pedestal surface of the terminal block overlap the conductive member holder in the radial direction, that is, the conductive member holder is nested in the terminal block, the conductive member holder can be protected by the terminal block.

(4) The rotary electric machine unit according to (3),

wherein the fastening surface of the case is provided with a guide protrusion (guide protrusion **112**), and

wherein the fixing portion of the terminal block is provided with a guide portion guided by the guide protrusion.

According to (4), since the conductive member holder is nested in the terminal block, the terminal block cannot be attached along the axial direction of the rotary electric machine in a state in which the rotary electric machine provided with the conductive member holder is disposed. However, the terminal block can be easily moved to a mounting position by moving the terminal block along the guide protrusion from a position slightly shifted from the conductive member holder.

(5) The rotary electric machine unit according to (4),

wherein the fastening surface of the case is provided with an abutting surface (abutting surfaces **113**A, **113**B), and

wherein the fixing portion of the terminal block is provided with an abutting portion (abutting portions **513**A, **513**B) that abuts against the abutting surface at the mounting position when the terminal block is moved from an initial position to a mounting position.

According to (5), when the terminal block is moved along the guide protrusion, the abutting portion of the terminal block abuts against the abutting surface of the case, so that the terminal block can be positioned at the correct mounting position.

The invention claimed is:

1. A rotary electric machine unit comprising:

a rotary electric machine; and

a case that accommodates the rotary electric machine, wherein:

the rotary electric machine includes:

a stator core;

a multi-phase coil that is attached to the stator core;

a conductive member holder that collectively holds a conductive member connected to a coil end of the multi-phase coil and is disposed outside the coil end in a radial direction; and

a terminal block that is fixed to a fastening surface of the case and electrically connects a terminal portion of a power distribution member with a terminal portion of the conductive member;

the terminal portion of the power distribution member and the terminal portion of the conductive member are disposed on a pedestal surface of the terminal block on a side opposite to the fastening surface, and are fixed by a fixing member;

the terminal block is disposed outside the conductive member holder in the radial direction, and includes a fixing portion fixed to the fastening surface;

the fixing portion and the pedestal surface overlap the conductive member holder in the radial direction when viewed from an axial direction; and

the conductive member holder is disposed between the fixing portion and the pedestal surface in the axial direction.

2. The rotary electric machine unit according to claim **1**, wherein:

the fastening surface of the case is provided with a guide protrusion; and

the fixing portion of the terminal block is provided with a guide portion guided by the guide protrusion.

3. The rotary electric machine unit according to claim **2**, wherein:

the fastening surface of the case is provided with an abutting surface; and

the fixing portion of the terminal block is provided with an abutting portion that abuts against the abutting surface at a mounting position when the terminal block is moved from an initial position to the mounting position.

* * * * *